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FUEL CELL
[Nenryo denchi]

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Claims

1. A type of fuel cell characterized by the following facts:

each unit cell is prepared by setting a matrix for holding an electrolyte on an anode electrode and cathode electrode pair having a fuel gas flow path and oxidant gas flow path; plural unit cells are stacked, and cooling plates are inserted at an appropriate interval in the unit cells to form a laminated stack;

on the side surfaces of said laminated stack, an oxidant gas feeding manifold and an oxidant gas exhaust manifold for feeding/exhausting the oxidant gas are arranged, respectively; on one side surface of the laminated stack, a fuel gas feeding manifold and a fuel gas exhaust manifold for feeding/exhausting the fuel gas to/from said anode electrode are arranged side-by-side; in this fuel cell, the cross-sectional area of the fuel gas flow path of the unit cell positioned in the lower portion of said laminated stack is larger than that of the unit cell positioned in the upper portion.

2. The fuel cell described in Claim 1, characterized by the fact that an aperture is arranged at the inlet of the fuel gas flow path of the unit cell to adjust the cross-sectional area.

Detailed explanation of the invention

Purpose of the invention

Industrial application field

The present invention pertains to a type of fuel cell. More specifically, the present invention pertains to a type of fuel cell characterized by the fact that improvement is made for uniform feeding of the fuel gas and oxidant gas to each cell in the laminated stack of the fuel cell.

Prior art

In the prior art, the fuel cell is a type of device that directly converts the chemical energy of fuel to electric energy. The fuel cell usually has the following constitution: as a unit cell, a pair of porous electrodes are arranged with a matrix holding an electrolyte sandwiched between them. Hydrogen or another fuel gas contacts the electrode back side on one side, and oxygen or another oxidant gas contacts the electrode back side on the other side, and the electrochemical reaction that takes place in this case is used to output electric energy from between said electrodes. Plural said unit cells are stacked to form the fuel cell. As long as said fuel gas and oxidant gas are fed, electric energy can be provided at a high conversion efficiency.

Figures 4(A), (B) illustrate the constitution of the fuel cell of this type in the prior art. As shown in Figure 4(A), matrix (1) impregnated with electrolyte is sandwiched. On its upper side, ribbed anode electrode (2) made of a porous material and having a catalyst coated on the side contacting said matrix (1) is arranged. On the lower side, ribbed cathode electrode (3) made of a porous material and having a catalyst coated on the side contacting matrix (1) is arranged. In this way, unit cell (4) is formed.

As shown in Figure 4(B), cooling plates (5) for cooling off the heat generated in company with the power generation reaction are inserted at an appropriate interval in laminated unit cells (4) in the fuel cell of the prior art.

Said unit cell (4) is sandwiched between sealing conductors (6) above and below it, respectively. By means of fastening fixtures (7) arranged above/below it, it is fastened and fixed in the laminating direction to form a laminated stack.

On the other hand, on the side surfaces of the main body of the cell, manifolds (8) are attached for feeding/exhausting fuel gas or oxidant gas.

On said manifolds (8), fuel gas/oxidant gas feed pipes (9) are attached, and by means of feed pipes (9), the fuel gas and oxidant gas are fed to each unit cell (4) of the stack cell.

Problems to be solved by the invention

The problems of said fuel cell of the prior art can be explained with reference to Figures 3(A) and (B).

For the fuel gas inside fuel gas feeding manifold (11) fed from fuel gas inlet (10), because the hydrogen concentration is high, the density is low. On the other hand, in fuel gas exhaust manifold (12), after passing through unit cell (4), because hydrogen has been consumed and water vapor has been mixed in, the density rises. As a result, as shown in Figure 3(B), for the distribution of pressure in the height direction of the laminated stack, due to the effect of the static hydraulic pressure ρgh (ρ: density, g: gravity acceleration, h: height), the pressure difference between the cell's inlet and outlet is larger for the upper portion of the cell and smaller for the lower portion of the cell. Consequently, the flow rate of the fuel gas flowing to the lower portion of the cell decreases.

As a result, for the lower cell of unit cell (4), during operation of the fuel cell, the fuel gas cannot be fed sufficiently. As a result, the characteristics of the cell in the lower portion degrade significantly. In addition, when the fuel gas lower than the necessary flow rate is fed, electrode reversal takes place in the cell, leading to damage of the cell itself. This is a major problem.

The purpose of the present invention is to solve the aforementioned problems of the prior art by providing a type of fuel cell characterized by the fact that a fuel gas can be fed uniformly to the various cells of the stack cell, and it is possible to improve the reliability and performance of the fuel cell.

Constitution of the invention

Means to solve the problems

For the fuel cell of the present invention, the cross-sectional area of the fuel gas flow path of the lower unit cell in the laminated stack is increased compared with that of the upper unit cell.

Operation

For the fuel cell of the present invention, because the cross-sectional area of the fuel gas flow path of the lower unit cell in the laminated stack is increased compared with that of the upper unit cell, the loss in pressure of the fuel gas flow path in the lower unit cell decreases, so that the fuel gas also can flow easily in the lower cell, and the fuel gas can be fed uniformly to the various cells in the stack cell.

Application examples

Constitution of the application example

As shown in Figure 1, in this application example, plural unit cells (4) are stacked, and cooling plates (5) are inserted at an appropriate interval between them to form a laminated stack. On one side surface of said laminated stack, fuel gas feeding manifold (11) for feeding fuel gas to anode electrode (2) is formed. On the opposite side surface, fuel gas exhausting manifold (12) for exhausting the fuel gas is arranged.

As shown in Figure 3(B), for the fuel gas at the inlet of the cell, because the concentration of hydrogen is higher, the density is lower. On the other hand, at the outlet of the battery, because hydrogen has been consumed and water vapor has mixed in, the density becomes higher. Due to the effect of static hydraulic pressure ρgh, for the pressure distribution in the height direction of the cell, the pressure

difference between the inlet and outlet of the cell is larger in the upper portion of the cell, and it is smaller in the lower portion of the cell.

Here, as shown in Figure 1, for said laminated stack, the constitution can be divided into three or more groups according to the difference in the fuel gas flow path's cross-sectional area of the unit cells. In this case, for the fuel gas flow path cross-sectional areas of the three groups of unit cells, in consideration of the pressure difference between the outlet and inlet of the cell caused by the pressure distribution in the height direction of the cell shown in Figure 3(B), the pressure loss in the fuel gas flow path is determined to have a balance with the pressure difference between the inlet and outlet.

That is, as shown in Figure 1(B), the lower the position of the laminated group, the larger the fuel gas flow path's cross-sectional area in this constitution (fuel gas flow path cross-sectional area of group A < group B < group C).

Operation of the application example

For the fuel cell of this application example with said constitution, for the fuel gas fed to the fuel gas feeding manifold, due to the effect of said static hydraulic pressure ρgh, the pressure difference between the inlet and outlet of the cell is larger for the upper portion of the cell and smaller for the lower portion of the cell.

In this case, for stack group C15 positioned on the lower portion, the unit cell's fuel gas flow path cross-sectional area is larger to reduce the pressure loss. Consequently, it is possible to reduce the pressure difference between the inlet and outlet of the cell, and at the same time, flow of the fuel cell is made easier. Consequently, it is possible to provide a fuel cell with uniformity for the various unit cells of the stack cell.

Effect of the invention

As explained above, by having a larger fuel gas flow path's cross-sectional area for the lower group of the stack cell, the fuel gas's flow for the lower unit cells is made easier. Consequently, the fuel gas can be fed uniformly to the various unit cells of the stack cell. As a result, it is possible to prevent the problem of insufficient fuel gas and deterioration in the cell characteristics for the lower unit cells that used to take place in operation of the stack cell, so that it is possible to improve the reliability and performance of the fuel cell.

Other application examples

The present invention is not limited to the aforementioned application example. As shown in Figure 2, one may also adopt a scheme in which aperture (16) is arranged at the inlet portion of the fuel gas flow path of unit cell (4) to control the pressure loss of the fuel gas flow path.

In this case, by positioning the cell with smaller aperture (16) in the lower group of the laminated stack, it is possible to facilitate flow of the fuel gas even when the pressure difference between inlet and outlet of the cell is small. The same effect as that of the present application example can be realized.

Brief description of the figures

Figure 1(A) is a cross-sectional view illustrating an application example of the fuel cell of the present invention. Figure 1(B) is an enlarged view of the main portion of the fuel cell shown in Figure 1(A). Figure 2 is an enlarged view of the main portion in another application example of the present invention. Figure 3(A) is a cross-sectional view illustrating the problem of the fuel cell in the prior art. Figure 3(B) is a diagram illustrating the difference in gas density between the inlet and outlet of the laminated stack.

Figure 4(A) is an oblique view illustrating the constitution of the unit cell. Figure 4(B) is a cross-sectional view illustrating the constitution of the fuel cell in the prior art.

Explanation of symbols

1 Matrix

2 Anode electrode

10 Fuel gas inlet

11 Fuel gas feeding manifold

12 Fuel gas exhaust manifold

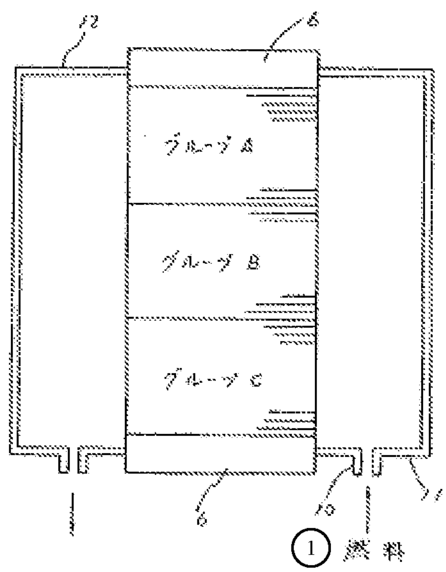

Figure 1(A)

Key: 1 Fuel

6 Group A

Group B

Group C

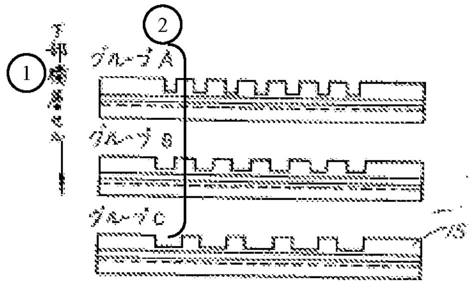

Figure 1(B)

Key: 1 Lower stacked cell

2 Group

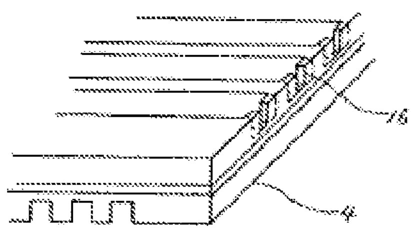

Figure 2

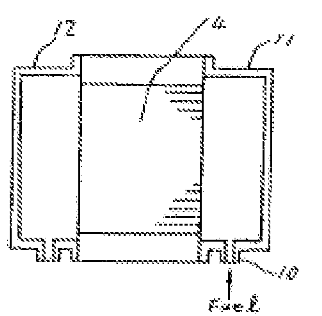

Figure 3(A)

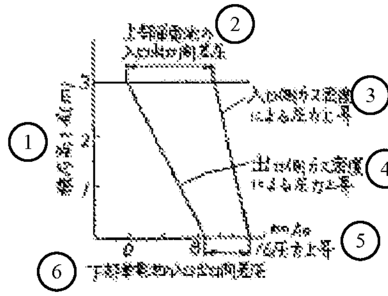

Figure 3(B)

Key:

1 Height of stack h

2 Pressure difference between the inlet and outlet of upper unit cell

3 Rise in pressure due to gas density on inlet side

4 Rise in pressure due to gas density on outlet side

5 Rise in pressure

6 Pressure difference between the inlet and outlet of lower unit cell

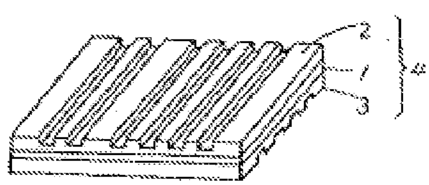

Figure 4(A)

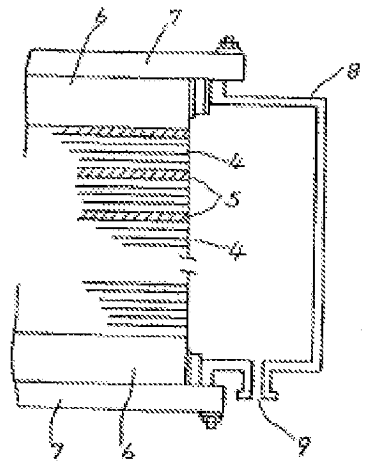

Figure 4(B)